

Project general information

PN-III-P4-PCE-2021-1548

Project PCE nr. 117

Contractor: University "Politehnica" of Bucharest

Director: Prof. dr. ing. Daniela-Cristina Berger

Project title

Design of novel composite materials based on mesoporous matrices by exploring the nanoconfinement effect (*COMCONF*)

Project scope

The project scope is the development of novel composites containing polyphenols nanoconfined into pores of mesoporous silica nanoparticles chemical modified to enhance their stability and to improve health benefits due to synergistic effect of components for topic applications with antibacterial properties.

Objectives

- (O1)** Optimisation of the extraction conditions to obtain polyphenolic extracts with desired chemical profile
- (O2)** Obtaining of appropriate modified mesoporous matrices for prepared extracts with tailored features
- (O3)** Obtaining novel formulations for extracts through encapsulation into a mesoporous matrix with health benefits
- (O4)** assessment of chemical stability of polyphenols when are encapsulated into mesoporous silica-type matrix
- (O5)** evaluation of cytotoxicity and bactericidal activity of developed formulations containing polyphenols.

Period of the project implementation

June 2nd 2022 - December 31st 2024 (31 months)

Abstract

The project deals with antibiotic-free antibacterial strategies based on nanomaterials, a hot topic of research because mankind is facing with a growing resistance on bacteria and aims to develop novel composites containing polyphenols nanoconfined into mesoporous silica nanoparticles (MSN) chemical modified to enhance their stability and to improve health benefits due to synergistic effect of components for topic applications with antibacterial properties. The project will explore unconventional extraction techniques (pressurized liquid extraction or ultrasound-assisted extraction) and pre-treatments to obtain phenolic extracts with desired chemical profile, surface engineering for the design of modified MSN to develop

novel formulations for extracts with health benefits, tailoring polyphenols - MSN interactions for enhanced phytochemicals stability when are encapsulated in MSN, as well as an appropriate release. Antimicrobial and effects at cellular levels of formulations containing polyphenols will be assessed. For extracts obtaining as vegetal material will be used wild berries from Romanian mountains. For envisaged application, mesoporous silica will be modified not only with organic groups, but also with inorganic nanoparticles (TiO₂, ZnO, Ag, or Cu) to contribute to composites bactericidal activity. The polyphenols-silica composite with best features will be incorporated in a natural polymer for wound dressing applications.

Project Team

Prof. Cristian Matei
CSIII Dr. Mihaela Deaconu
As. Dr. Ana-Maria Brezoiu
CSII Dr. ing. Raul-Augustin Mitran
CSII Dr. Ana-Maria Prelipcean
Drd. Simona Ioniță
Drd. Daniel Lincu
CSI Eugeniu Vasile

Estimated results

3 formulations containing chemical modified silica as matrix for polyphenols with antioxidant activity, antimicrobial potential and good biocompatibility
4 ISI papers
1 patent application
6 presentations in conferences.

Hypothesis

The development of novel nano-systems containing polyphenols whose stability over time will be improved due to the nanoconfinement into the mesopores of the silica-type carrier, which will be designed for destroying bacteria and prevent biofilm formation, while a good biocompatibility will be maintain for the use in topic applications. For envisaged application, the mesoporous silica will be modified not only with organic groups, also with inorganic NP like TiO₂ or ZnO, which offer protection against UV radiations, or Ag or Cu, but also can contribute to the bactericidal activity of developed composites. The composite powder containing polyphenols confined into the pores of a modified mesoporous silica matrix with the best features, including antimicrobial activity will be incorporated in a natural polymer for wound dressing applications.